THE EXPERIMENTAL IST

Moçambique January 07/2010 The Science and Technology Magazine Volume 1 Nº 1

Editorial

In this magazine we hope to bring you practical scientific and technological information useful for schools and communities in the rural Districts of Mozambique. And for towns and cities as well of course, but with the accent on the rural areas. President Gebuza has said that the District should be the pole of development.

Our schools rarely do science experiments; as a result pupils do not understand real science. And communities do not know how to make use of the many technologies that could improve their lives.

Most of these people – men, women, students, young people, teachers – are poor and have no access to the expensive materials that are usually used for science teaching. All too often there are not even any scissors in the school, nor water pumps in the village.

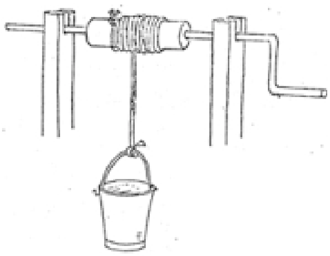
So the solutions that we offer in this magazine need only easy-to-get resources. We present a range of practical experiments, especially in the area of Physics, which are normally particularly difficult to do. We also have a section on aspects of modern science and technology.

We have called the magazine 'The Experimentalist' because the material is based on the research and experiments of the 'Grupo Faísca' (the 'Spark Group') based in KaTembe, in the Province of Maputo.

The Space Shuttle

Model of a Persian Wheel

Methods of raising water from a well



The traditional method of raising water from a well is a ‘windlass’.

But a much easier method is a ‘Stork’ – so-called because when it is working it looks like a stork catching fish.
Its parts are poles of wood or bamboo. Two of these are fixed vertically; the other is a movable arm.
The arm is hung high up between the two vertical poles by means of an iron rod going through all three poles.

Alternatively the arm can be hung from a single pole by a short rope (Figure 6).

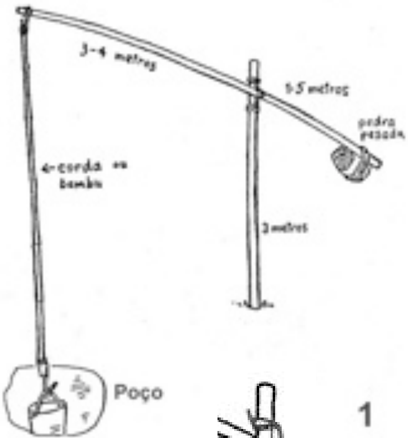
At the long end of the movable arm is a rope and a bucket (or the rope could be a thin bamboo).

At the shorter end, there is a sack of sand (or a heavy stone). This acts as a counter-weight. You adjust its weight and position until it will balance the bucket full of water. In fact, it should be a bit heavier so that when you let go of the rope, the bucket comes up on its own.

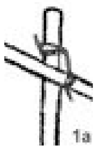
You pull the rope down so that the bucket goes down and fills with water. Then you let go of the rope, and the bucket comes up on its own because of the counter-weight. Then you empty the bucket into a canal that goes to your vegetable garden. The diagrams show how it works.

The big advantage of the Stork is that you do not have to pull the water up. You only have to pull the rope down, which is much easier.

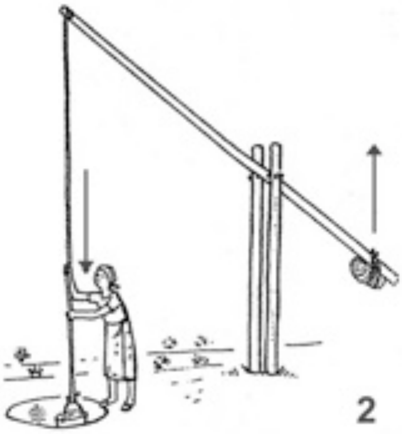
The photos show examples of Storks in action (in Thailand and Bangladesh). Both of these use a single vertical pole.



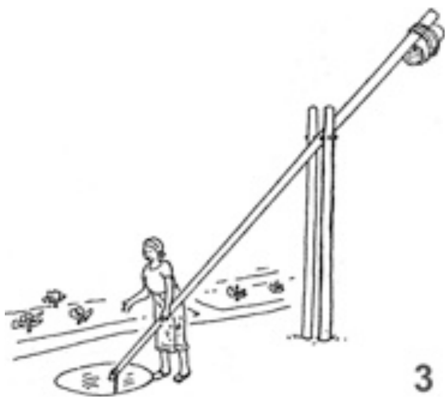
1



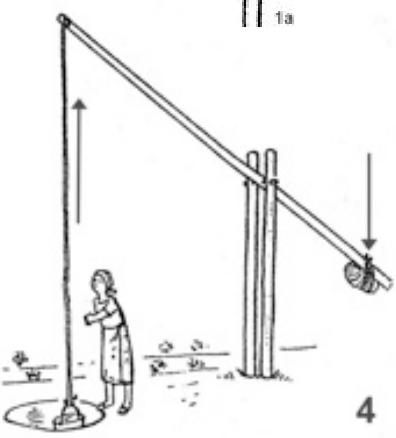
1a



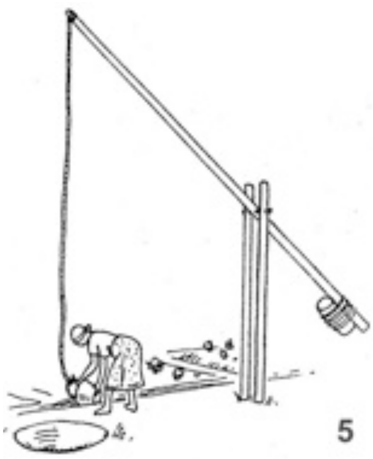
2



3



4



5

7


Examples of “storks”

An automatic bucket

The following series of photos show how to make a bucket that fills automatically when it goes down into the water. It is especially useful for the Stork device

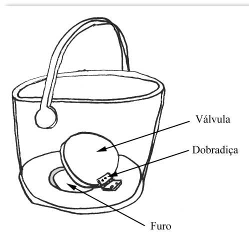
The bucket has a wide hole in the bottom, with a hinge and a ‘flap valve’ that opens when water wants to come upwards into the bucket, and closes if the water tries to go out.



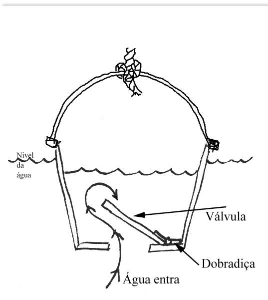
The hinge is a piece of strong cloth.

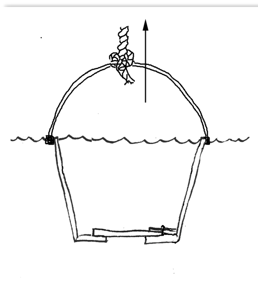
When the bucket goes into the water, the valve opens and allows the water to enter. The bucket sinks.

When you pull up the rope of the Stork, the valve closes because of the weight of the water, and the water does not go out.



We made the valve of wood for the first attempt, but it did not work well because the flap valve tended to float. Later, we put a piece of iron on top of it, and then it worked well.

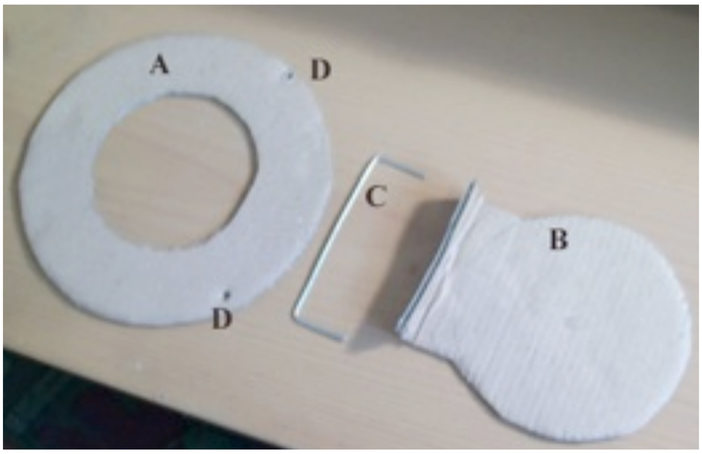


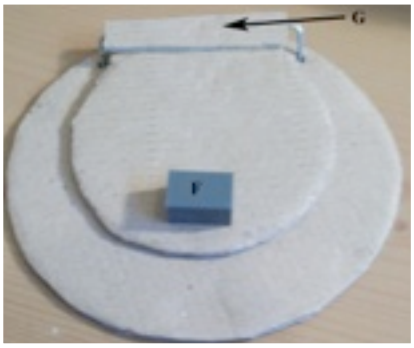


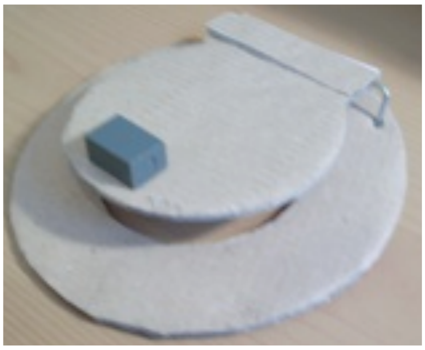
A metal valve is better. The following photos show the idea. These are models made of cardboard. The real thing should be made of metal sheet.

The photo is of Sr Bombe, one of our Grupo Faísca, at the side of his well.

A – The bottom of the bucket, or a separate sheet of metal.
B – The flap valve. It needs some plastic sponge glued below to make it water tight.
C – Strong wire.
D – Holes which the wire goes through. These must be a bit bigger than the wire in order to let the valve go up and down easily.
E – The space here must be rather open, not tight.
F – A piece of metal as a weight to help the valve close quickly and tightly.
G. etc. – Views from other angles.



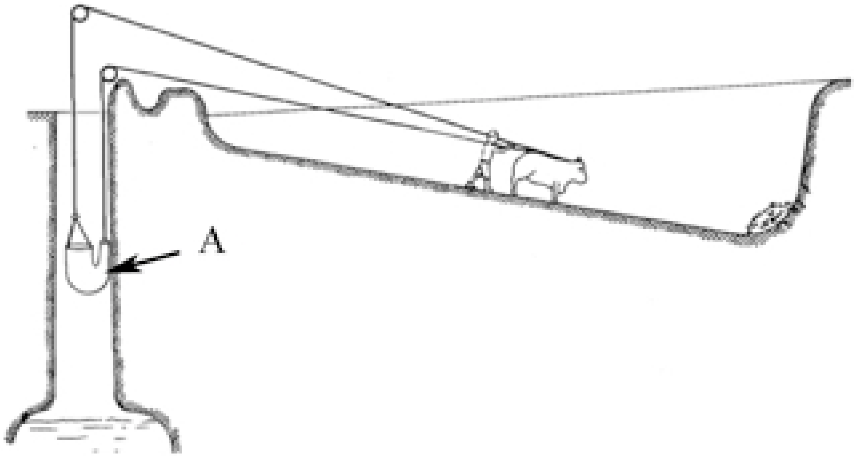




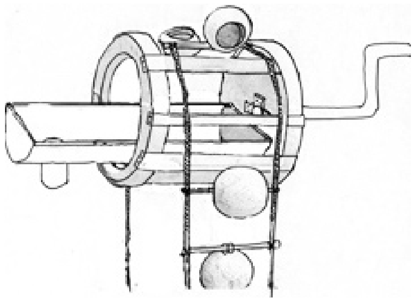
Commercial flap valves >

An interesting method of raising water, using an animal

A – Bucket made of leather, 50 litre



Other manual methods



The Persian Wheel. To raise water from a well.

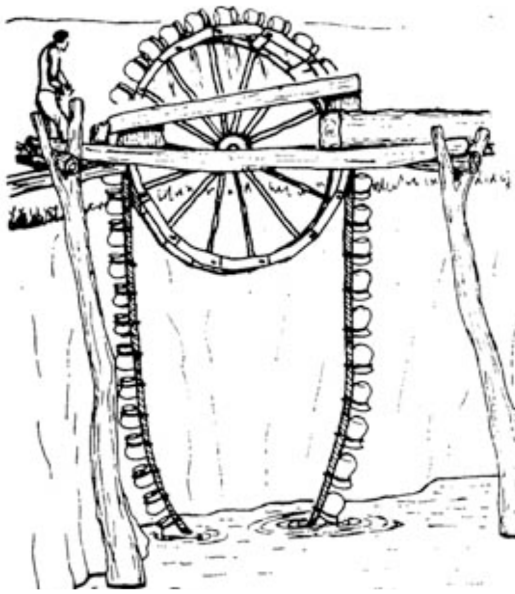
A long loop of rope is hung from a horizontal cylinder that can be turned by a handle. The loop goes down into the water. When you turn the handle, one side of the loop goes down into the well and the other side comes up.

There are tins or small buckets attached to the rope at intervals of about half a metre. These bucket come up full of water. When they arrive at the top they tip the water into a channel.

Then they go down the other side into the well (upside down), into the water and fill up, ready to go up again.
In fact there are two ropes to keep the buckets upright.

The photo shows a model made with gourds to represent the buckets. The photo is of Zacarias Bombe of the   Faísca Group in KaTembe in 2003.

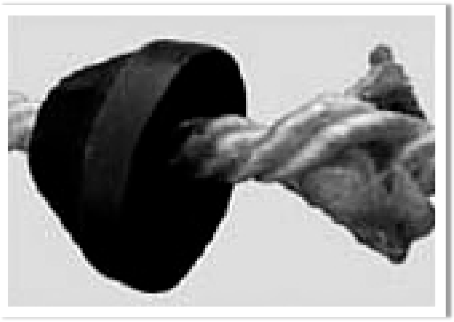
The device is called a Persian Wheel.
You can see a real example on the Internet. Look up "Persian Wheel – Araghatta" on Google.



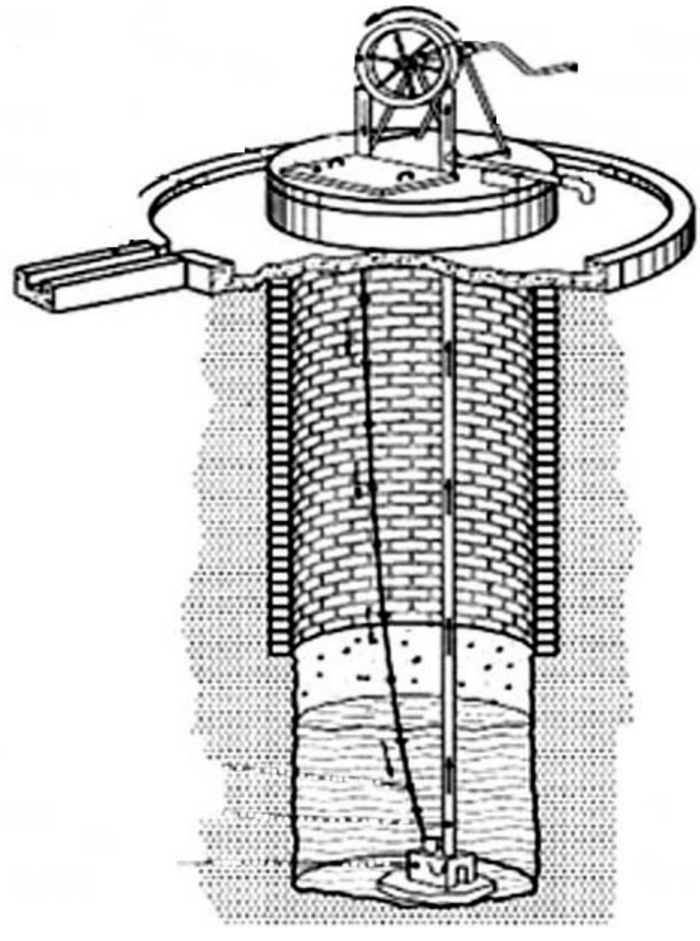
Animal traction is used to operate the Persian wheel to raise water for irrigation.

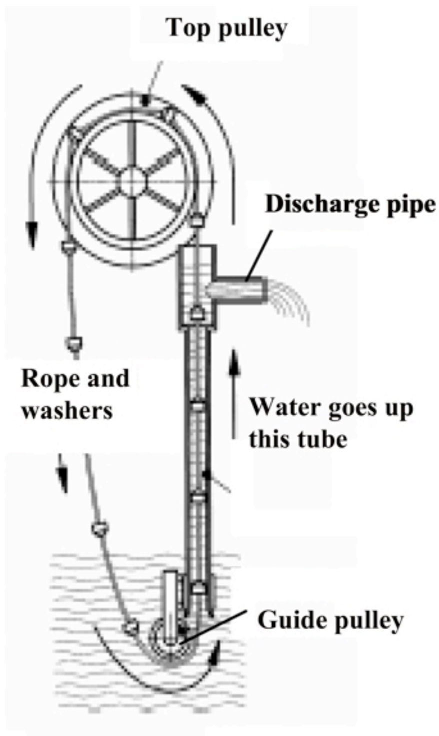
A Rope and Washer Pump

Another type of pump, which works much quicker, is a “Rope and Washer Pump”. This is basically a tube inside which is a rope with rubber rings (pistons) along it. The lower part of the tube is in the water down in the well. This rope and the washers go up the tube and push the water up.



The pistons are circles of rubber cut from car tyres or knots or something similar to serve as pistons, spaced along the rope.





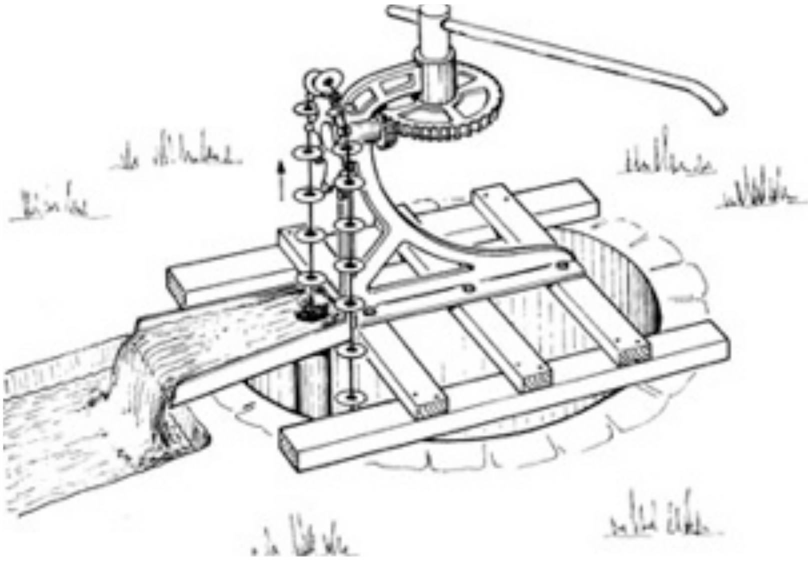
When you turn the handle, the rope and washers come up the tube and bring up water. At the top of the tube the water goes out through a pipe at the side.

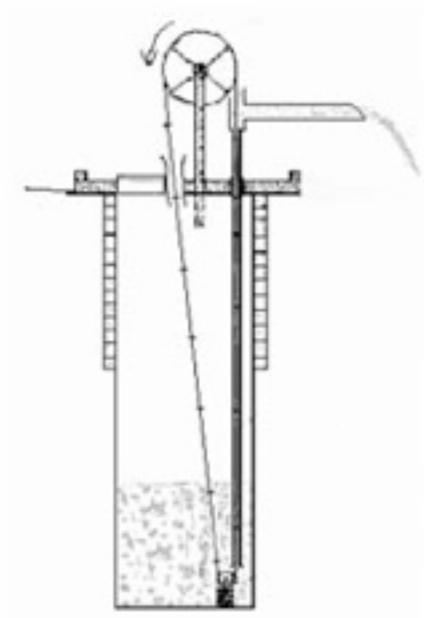
The front cover of this magazine shows a rope and washer pump in action in Mozambique. Pumps of this size can supply water for drinking and washing for about 400 people a day. Or irrigate a hectare of land.

There are photos of many examples on the Internet at <http://www.akvo.org/wiki/index.php/Rope_pump>

The introduction of this technology in Mozambique started in 1990 with the installation of 10 rope pumps in Manica province by the non-governmental organization, PumpAid.
In July 2003, the use of rope pumps in the country had a considerable growth because of the import of 60 pumps from Madagascar, for the ngo "WaterAid" in Niassa.
After the introduction of the rope pump in Niassa, the Government decided to extend the experience through pilot projects for the provinces of Cabo Delgado, Zambezia and Nampula.
In 2005 the National Water Directorate (DNA), in coordination with members of the Group of Water and Sanitation (group GAS), developed a project for the Development and Production of rope pumps in Mozambique.

The simplicity of manufacture and maintenance of the pump allowed its construction by domestic industry, by artisans in the province of Niassa. Currently there are three constructors of rope pumps in Lichinga, Pemba and Quelimane. In 2005 a technical team was formed, composed of technicians from the Vocational Training Centre for Water and Sanitation (CFPAS) and the Engineering Laboratory of Mozambique (LEM).





ZEER POTS

Cooling by evaporation is one of the oldest methods of keeping things cool.

The water is kept fresh in wet vases or clay pots. Because the clay is a porous material, the water passes through the clay and evaporates to the outside air. Thus it removes heat from the water in the pot. Water molecules evaporate, they absorb heat, and thus the evaporation produces cold, keeping the water inside the pot always fresh.

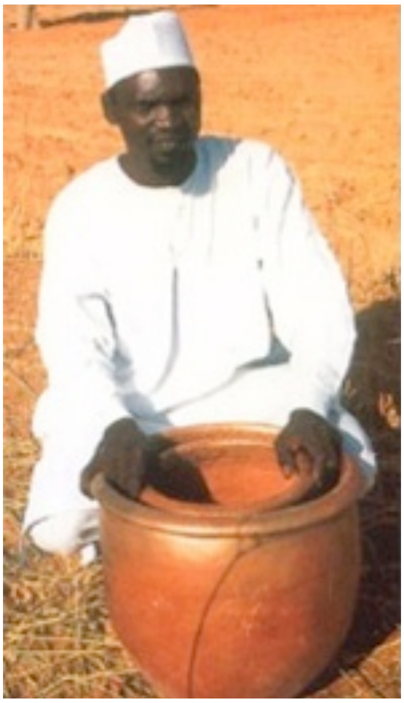
The same effect occurs when we sweat. The function of the evaporation of sweat is to reduce our skin temperature.

When water molecules evaporate, they "steal" the heat of the molecules inside the pot, thus cooling the water. This 'cooler', the cheapest in the world, costs very little to make, uses minimal resources, and runs completely without electricity. It is called a 'Zeer Pot'.

It consists of two common pots or vases of baked clay, (i.e. the cheapest, without glaze). If there are holes in the bases of the vessels are closed so as not to let water escape.

One pot is smaller than the other. The smaller pot is put inside the bigger one and the space between them is filled with sand. The sand is wetted with water twice daily. Fill it until the water is visible above the sand.

A wet cloth is put on over the pots to prevent outside air from entering.



The Zeer Pot should be placed in the shade, in a place where there is wind (which increases the evaporation).

It is used for soft drinks, water, fresh fruit and vegetables. In this way, the product can be maintained fresh for long periods of time. Tomatoes and peppers last up to three weeks. Fish that normally rot after only one day, stay eatable fo two or three days. Eggplants will keep for up to 27 days instead of three. It is a good idea to wrap food items in a separate piece of plastic.

The Zeer pot will keep the inside temperature at approximately 10 degrees Celsius below the temperature outside.

Fresh produce is kept inside the pot, with one or two cool items exposed in the damp cloth over the pot. In this way, the product is kept hidden away from the hot air and insects.

You can put the Zeer Pot beside the door behind the house, beside a hut beside the road, etc.

The International Space Station

The construction of the ISS in orbit began in 1998. It can be seen from Earth with the naked eye. Traveling at an average speed of 27,700 km/h, the Station completes many orbits per day.

Men and equipment are transported to the ISS by the Space Shuttle – part rocket, part aircraft. >>

The ISS represents a permanent human presence in space and has been maintained with a crew of not less than two since November 2, 2000. The ISS involves several space programs, including the National Aeronautics and Space (National Aeronautical and Space Administration, NASA) of the United States of America, the Russian Space Agency and several European agencies.

The space station is in orbit around the Earth at an altitude of about 360 kilometers, an orbit usually termed "low Earth orbit". In fact, the height varies over time by several kilometers due to atmospheric drag.

The station loses on average 100 meters of altitude per day and orbits the Earth in a period of about 92 minutes. On June 27, 2008 (at 01:01 UTC) completed 55,000 orbits

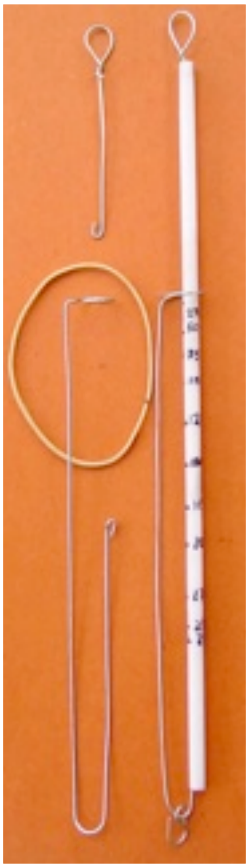
The station is serviced primarily by the Space Shuttle and the Russian Soyuz spacecraft. Is still under construction, although it is continuously used for conducting scientific experiments. Currently the station carries a crew of six.

The International Space Station (ISS) is a satellite that circulates between 350-460 km above the Earth. It is a space laboratory.

How to Make a Balance from a Drinking Straw

In a science class at school, a small balance is often required. This book shows how to make one that is very easy and inexpensive. The teacher can divide the class into groups and each group can make a balance and use it. Appropriate experiments are suggested at the end of this booklet.

The balance is made from a wide plastic straw and thin wire. Thin galvanized wire is best but any kind of wire will do if you can bend it easily. You can bend it with your fingers but pliers make the bends neater. The photos show the main parts of the balance



So you need a rubber band. It should be thin to go into the straw easily.
Or you can cut a thin strip of rubber of an inner tube of a bicycle with a razor blade or scissors. But a rubber band is better.

Other photos show the other pieces and how to connect them.

The rubber band is stretched between two hooks. Before making the top loop, pull the rubber band to the upper end of the straw.

Then make the loop. This loop is the pointer that indicates the weight.

Then close the hooks so that the elastic does not fall off. Make a small hook on the bottom for hanging things.

If the elastic is thin, the balance is sensitive. That is, it will weigh light things. If it is thicker, it will weigh heavier things.

If you want to weigh liquids, use a plastic bag.
Make a small plastic bag. (Cut it from a larger plastic bag.) Hang it like you see in the picture. Where the pointer is, mark a small line on the straw with a '0 'next to it (to mean zero). Use a pen with permanent filter (a marker). It writes better on the straw.

You can call it zero because the weight of the small plastic bag is insignificant.

Now you must calibrate it: that is, put marks on the straw to show the weight of what is hanging on the hook. Of course if you have real small weights, you can put them on the hook and mark where the pointer is. But almost no school has real weights. So here is a simple method:

Put 25 milliliters of water (which weighs 25 grams) in small plastic bag. (You can measure milliliters of water with an old syringe from a clinic.) The weight of a small plastic bag is so small you can ignore it.
Make a short line on the straw and write '25 '.
Then put in another 25 ml ... and so on. With a thin elastic band, the limit is approximately 250 grams.

Instead of a syringe, can use a measuring jug from the kitchen.

Then remove the bag. Now you have a balance that can be used for many experiments.

If you want to weigh solid things, make a pan from a phone card or something similar. Make small holes with a bit of wire. Then cut two pieces of thin wire and pass them through the holes and bend the ends so they will come out. The photo shows how it is done.

Note the weight of the plate and subtract this value from the indicated weight of the thing that weighs later

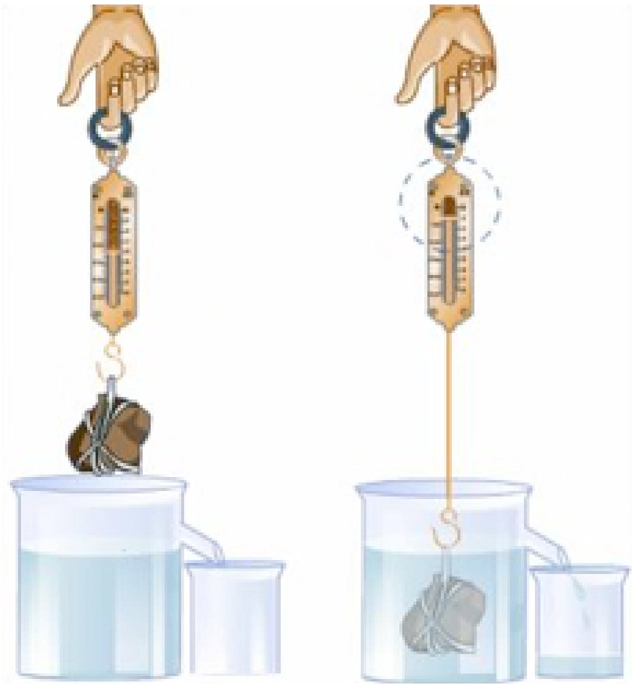
Another method is to calibrate the scale: Metical using coins as weights.

Here is a list of weights of the coins of Mozambique (new family). (And for your interest, the diameters.)
MT 10 - Weight: 7,50 grams. Diameter: 25,00 mm
MT 5 - Weight: 6,50 grams. Diameter: 27,00 mm
MT 2 - Weight: 6,00 grams. Diameter: 24,00 mm
1 Metical - Weight: 5,30 grams. Diameter: 21,00 mm

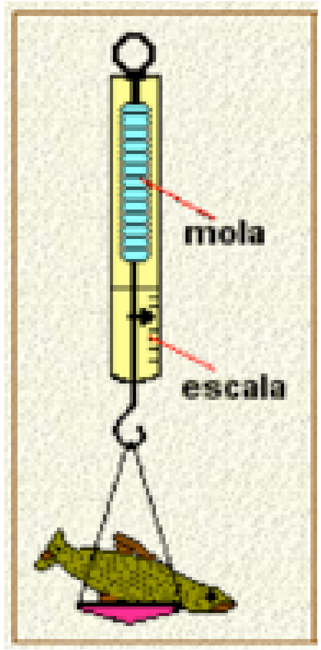
The young students of Group Spark with the instructor Alberto Chapola

A Spring Balance

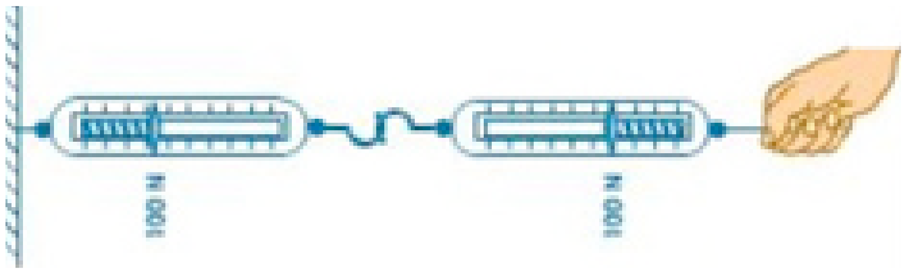
This balance is an example of what is called a "spring balance" – the type used in a school laboratory (and which is illustrated in school physics books). It uses a helical steel spring >

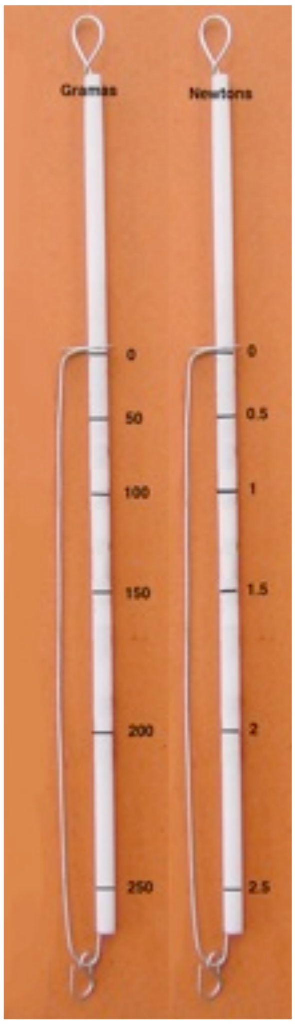


The interior is like this >

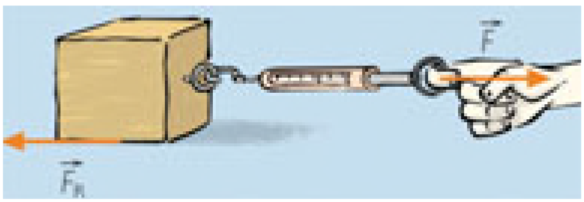


Measuring forces
The straw balance not only serves to weigh things but to measure forces. In this case it is called a dynamometer, and must be calibrated in Newtons. A Newton is equivalent to a weight of 98.1 grams, which is approximately 100 grams. For demonstration purposes, we can use this figure of 100 grams.





An example of an experiment that is used is the demonstration of the Principle of Archimedes.
For example, 'Action and reaction are equal and opposite'.



Or to measure friction

Or to measure other forces >